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Wanner

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[54] COOLING SYSTEM FOR PORTABLE IMPULSE TRANSMITTING MACHINES

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[52] **U.S. Cl.** **173/117**, 173/122

[51] **Int. Cl.** **B25d 13/00**

[58] **Field of Search** 173/75, 117, 123, 122

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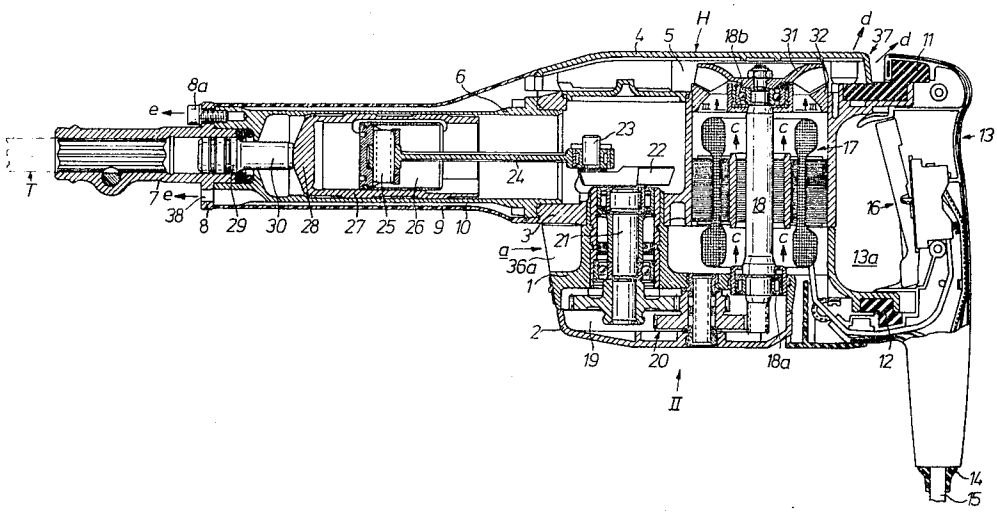
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[57] **ABSTRACT**

A portable impulse transmitting machine wherein an impeller assembly receives motion from an electric motor and serves to drive a tool into concrete, rock or like formations with attendant heating of the motor and impeller assembly. The housing of the machine forms part of the cooling system for the motor and the impeller assembly and accommodates a radial fan which is driven by the motor. A first portion of the housing has a plastic jacket which surrounds the impeller assembly and defines an annular passage one end of which is adjacent to the pressure side of the fan and the other end of which communicates with the atmosphere by way of one or more outlets. A second portion of the housing surrounds the motor and the fan and is provided with one or more inlets for admission of atmospheric air and with one or more channels which connect the inlets with the first end of the passage and draw substantial quantities of atmospheric air along the motor in response to rotation of the fan. A portion of the air which cools the motor is caused to flow through the passage to be expelled by way of the outlets and the housing is provided with additional outlets adjacent to the pressure side of the fan to permit escape of the remaining portion of air which is delivered by the channels.

11 Claims, 5 Drawing Figures



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SHEET 1 OF 3

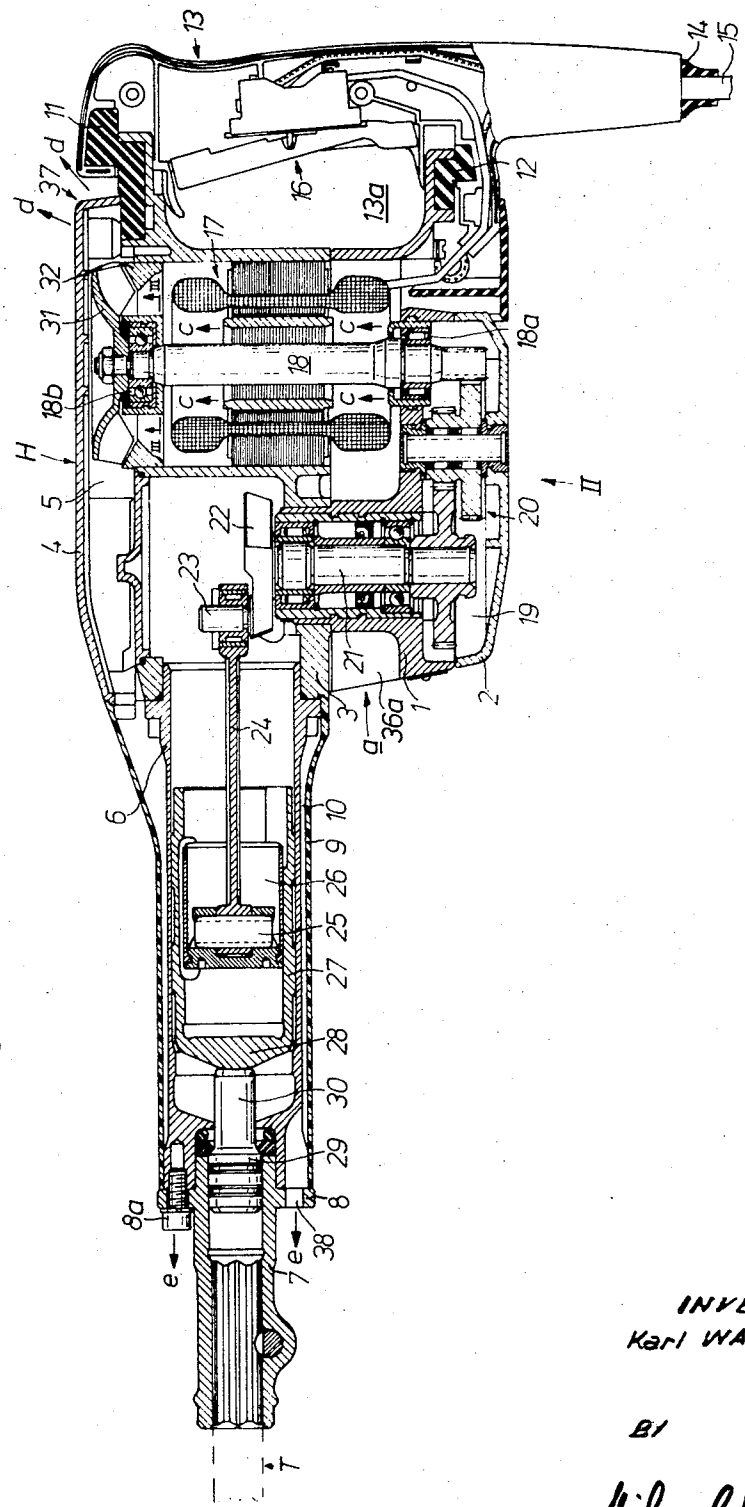


Fig.1

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Fig. 2

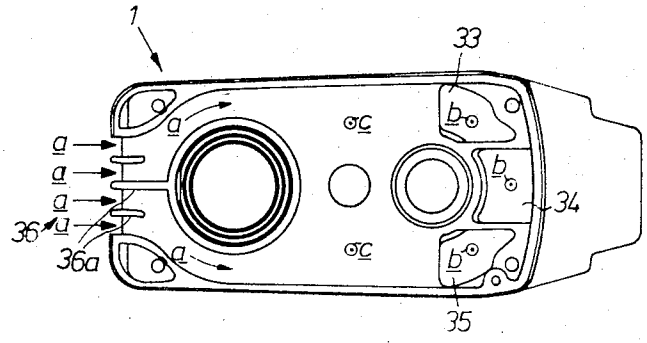
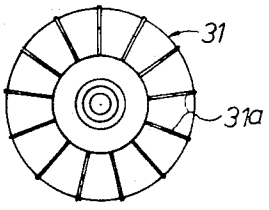


Fig. 3



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Fig. 4

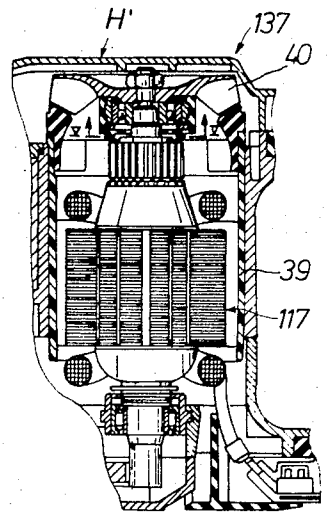
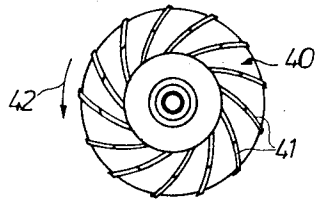


Fig. 5



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COOLING SYSTEM FOR PORTABLE IMPULSE TRANSMITTING MACHINES

BACKGROUND OF THE INVENTION

The present invention relates to improvements in portable impulse transmitting machines, and more particularly to improvements in portable hammers wherein an electric motor drives an impeller assembly which transmits recurring impulses to a tool to facilitate penetration of the tool into rock, concrete or like substances. Still more particularly, the invention relates to improvements in cooling systems for the motor and other parts of portable impulse transmitting machines.

A drawback of presently known cooling systems for manually manipulated impulse transmitting machines is that the temperature of the air stream or streams which are used to cool the impeller assembly is often so high that the parts which are gripped by the operator's hands are over-heated, especially when the machine is in use for relatively long periods of time. This is due to the fact that the fan which draws streams of cooling air along the motor conveys the thus preheated air along the impeller assembly. While exchanging heat with the parts of the motor, the air streams are heated to a very high temperature, and such air streams are thereupon compelled to flow along the impeller assembly as well as along certain exposed parts which are touched by the user of the machine. As a rule, the impeller assembly is surrounded by a metallic jacket which confines the preheated air streams and is thereby heated to an elevated temperature so that it cannot be touched by hand at all or can be gripped by hand only for a short interval of time, namely, immediately after the motor is started. Furthermore, the streams of preheated air are likely to adversely affect the operation of the impeller assembly. The jacket is heated by air streams which are about to come into contact with the impeller assembly as well as by air which has been heated to a still higher temperature in response to exchange of heat with the impeller assembly.

SUMMARY OF THE INVENTION

An object of the invention is to provide an impulse transmitting machine, particularly a portable hammer wherein the impeller assembly receives motion from an electric motor, with a novel and improved cooling system which insures that the temperature of air which is used to cool the impeller assembly cannot rise to a value at which the exposed parts of the machine cannot be touched by hand.

Another object of the invention is to provide the housing of an impulse transmitting machine with a novel system of chambers, passages, openings, channels and conduits for circulation of air which serves to cool the motor and the impeller assembly.

A further object of the invention is to provide a cooling system which can be incorporated in certain presently known impulse transmitting machines without necessitating appreciable changes in the dimensions, configuration and/or construction of such machines.

The invention is embodied in a portable impulse transmitting machine which comprises an electric motor, an impeller assembly which is operable to transmit axially oriented impulses to a material penetrating tool,

a transmission or other suitable motion transmitting means for operating the impeller assembly in response to operation of the motor whereby the motor and the impeller assembly generate heat, and novel cooling means which includes a specially designed housing for the motor, motion transmitting means and impeller assembly, and a rotary fan which is driven by the motor. The housing comprises a first portion which surrounds the impeller assembly and defines a preferably annular passage having a first end adjacent to the fan and a second end adjacent to the tool and communicating with the atmosphere by way of at least one first outlet. A second portion of the housing surrounds the motor and the fan and has at least one air-admitting inlet and at least one channel which extends from the inlet, along the motor and communicates with the first end of the passage. The fan is mounted between the passage and the channel so that its suction side faces the motor and is designed to draw through the inlet and the channel an air stream containing such quantity of air which greatly exceeds the quantity necessary for proper cooling of the impeller assembly and of the motor. Thus, the large quantity of air which flows through the channel and exchanges heat with the motor is heated to a relatively low temperature, and a portion of such air is thereupon forced to flow through the passage and to escape by way of the first outlet. The remaining portion of air which is drawn by the fan is permitted to escape into the atmosphere by way of one or more second outlets provided in the housing in the region of pressure side of the fan. Thus, the fan can draw through the channel a substantial quantity of air which insures proper cooling of the motor and is not overheated before a minor portion of it enters the passage to exchange heat with the impeller assembly.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved cooling system itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a partly elevational and partly longitudinal vertical sectional view of a portable impulse transmitting machine having a cooling system which embodies one form of the invention;

FIG. 2 is a fragmentary bottom plan view of the machine, substantially as seen in the direction of arrow II in FIG. 1;

FIG. 3 is a plan view of the fan of the cooling system as seen in the direction of arrows from the line III—III of FIG. 1;

FIG. 4 is a fragmentary vertical sectional view of a second impulse transmitting machine having a different electric motor and a modified cooling system employing a different fan; and

FIG. 5 is a plan view of the fan as seen in the direction of arrows from the line V—V of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1, there is shown a portable impulse transmitting machine which is used as a hammer to drive a tool T axially into rock, concrete or like material. The machine comprises a composite housing H which forms part of the improved cooling system for an electric motor **17** and an impeller assembly which is installed in a tubular member **6** forming part of a first or front portion of the housing H and supporting a tubular holder **7** for the tool T. The holder **7** is secured to a flange **8** at the front end of the tubular member **6** by one or more screws **8***a* or like fasteners. The first or front portion of the housing H further comprises a sleeve-like plastic jacket **9** which surrounds the tubular member **6** and defines therewith an elongated annular passage **10** extending from the flange **8** in a direction toward the motor **17**. The flange **8** is formed with one or more outlets **38** which permit escape of an air stream after the air stream exchanges heat with the tubular member **6** and with the impeller assembly during flow through the passage **10**.

The second or rear portion of the housing H surrounds the motor **17** and a radial fan **31** which is coaxial with and is mounted at a level above the motor **17**, as viewed in FIG. **1**. The second housing portion comprises a lower section **1**, an upper section **3**, a lower shell **2**, an upper shell **4** and a handle **13**. The section **1** is of generally rectangular outline and is provided with several cavities which will be described later. The shell **2** is adjacent to the underside of the section **1** and the shell **4** is adjacent to the upper side of the section **3**. The sections **1** and **3** are bolted or otherwise rigidly connected with each other. The space **5** between the section **3** and the upper shell **4** constitutes a plenum chamber which communicates with the rear or right-hand end of the passage **10**.

The tubular member **6** is threadedly connected with the front end of the section **3**. In the illustrated embodiment, the jacket **9** consists of polyamide and its rear portion tapers toward the flange **8** of the tubular member **6**.

The handle **13** is connected with the sections **1** and **3** by interposition of elastic cushions **12**, **11** and is provided with an opening **13***a* for insertion of four fingers of one hand while the other hand of the user grips the jacket **9**. The opening **13***a* accommodates the actuating element of a rocker arm switch **16** which can open or complete the circuit of the motor **17**. The handle **13** is further provided with a downwardly extending portion carrying an elastic sleeve **14** of insulating material which surrounds a portion of an electric cable **15** serving to connect the motor **17** with a source of electrical energy in response to closing of the switch **16**.

The motor **17** is a high-frequency polyphase current motor and comprises a vertical output shaft **18** which is substantially parallel to the handle **13** and substantially normal to the tubular member **6**. The lower portion of the shaft **18** is rotatable in a needle bearing **18***a* and its upper portion is rotatable in a ball or roller bearing **18***b*. The bearings **18***a*, **18***b* are respectively mounted in the housing sections **1** and **3**. The section **1** defines with the shell **2** a compartment **19** which accommodates a transmission **20** serving as a means for transmitting motion from the output shaft **18** of the motor **17** to the impeller assembly in the tubular member **6**. The transmission **20** comprises a vertical crankshaft **21** which is rotated by the shaft **18** through the intermediary of a gear train and carries at its upper end a disk **22** for an eccentric crank pin **23**. The crank pin **23** is surrounded by the strap of a rod **24** which is coupled to a piston **26** by means of a pin **25**. The piston **26** is reciprocable in a hollow cylindrical impeller **27** which has a reinforced front wall **28** serving to strike against a rearwardly extending stub **30** of an anvil **29** in the rear portion of the holder **7** whereby the anvil strikes against the shank of the tool T and drives the latter into a wall or the like when the crankshaft **21** rotates in response to completion of the circuit of the motor **17** by the switch **16**. The exact construction of the impeller assembly including the parts **24** to **30** forms no part of the present invention.

The upper end portion of the output shaft **18** of the motor **17** extends beyond the bearing **18**b and is connected with the radial fan **31**. The latter is mounted in the chamber **5** and has a set of The latter flat or straight radially extending blades **31***a* (see FIG. **3**). Such configuration of the blades **31***a* is desirable because the motor **17** can rotate its shaft **18** in both directions. The suction side (or underside) of the fan **31** faces the motor **17** and draws air through several channels which are provided in the second housing portion including the parts **1** to **4** and **13**. The suction side of the fan **31** is adjacent to an air guiding ring **32** which is separated from the lower edge faces of the blades **31***a* by a narrow gap shown in FIG. **1**. The ring **32** directs the upwardly flowing air streams into the spaces between the blades **31***a*.

FIG. **2** shows that the housing section **1** is provided with three cutouts **33**, **34**, **35** which are adjacent to the needle bearing **18***a* and communicate with air-admitting inlets **36** provided in the front portion of the section **1**. The inlets **36** are at least partially separated from each other by stiffening and air-guiding ribs **36***a* of the section **1** and are provided in the region of the crankshaft **21**. The parts **1–4** of the second portion of the housing H define several channels which include the cutouts **33–35** and serve to convey streams of cool atmospheric air from the inlets **36**, along the parts of the transmission **20**, thereupon along the motor **17** and to the suction side of the fan **31**. When the motor **17** drives the fan **31**, the air streams enter the housing H by flowing in the direction indicated in FIG. **2** by arrows *a*. Such air streams thereupon cool the bearings for the crankshaft **21** and flow along the upper part of the compartment **19** and flow in the directions indicated by arrows *b* toward the motor **17**. The air streams thereupon flow through the cutouts **33–35** and are accelerated to flow along the parts of the motor **17** (arrows *c*) to exchange heat with such parts and to insure that the temperature of the motor remains below a predetermined value. The air which is drawn through the suction side of the fan **31** enters the chamber **5** (which can be considered as constituting the rearmost portion of the passage **10**) and a portion of such air flows forwardly through the passage **10** to cool the member **6** and the impeller assembly **24–30** in the member **6**, and to escape into the atmosphere by way of the outlets **38**.

In accordance with a feature of the invention, the second portion of the housing H is further provided with additional outlets which are openings provided in the upper shell **4** in the region indicated by the arrow **37** to permit escape of substantial quantities of air in directions indicated by arrows *d*. The dimensions of the outlets **37** and **38** are selected in such a way that the outlets **37** normally permit escape of at least 50 percent but preferably up to 66 percent of the total quantity of air which is drawn into the chamber **5** by the fan **31**.

The directions in which the twice heated portion of air is discharged into the atmosphere by way of the outlets **38** is indicated by arrows *e*. Such air can be directed against the region where the tool T penetrates into a wall or the like to blow away small particles and dust.

The air circulating capacity of the fan **31** is selected in such a way that the temperature of the large quantity of air flowing along the motor **17** (arrows *c*) considerably exceeds the minimum quantity which is needed for proper cooling of the motor. Therefore, the temperature of air which enters the chamber **5** is relatively low so that the air which flows through the passage **10** is sufficiently cool to effect satisfactory cooling of the tubular member **6** and impeller assembly **24–30** as well as to prevent overheating of the plastic jacket **9**. Thus, the jacket **9** can be grasped by hand and can constituted an auxiliary handle which is gripped by one hand while the other hand grips the handle **13** and operates the switch **16**. It is preferred, at this time, to employ a fan which can draw through the inlets **36** an air stream capable of properly cooling the motor **17** and at least one-half of which is expelled through the outlets **37** at the pressure side of the fan. The remaining portion of incoming air suffices to insure satisfactory cooling of the parts **6** and **24–30** without overheating the jacket **9** and escapes by way of the outlets **38** to preferably perform the additional desirable function of cleaning the area where the tool T penetrates into a wall or the like. Thus, the quantity of air which the fan **31** can draw through the inlets **36** considerably exceeds the quantity of air which is circulated in conventional machines wherein all of the air which is used for cooling of the motor is also used for exchange of heat with the impeller assembly. Even though the air which flows through the passage **10** is heated in response to exchange of heat with the parts **6** and **24–30**, its temperature can be kept sufficiently low to prevent overheating of the jacket **9**. The material of the jacket **9** is preferably a poor conductor of heat.

FIG. **4** illustrates a portion of a second machine wherein the second portion of the housing H′ surrounds a universal motor **117**, namely, a motor which can be operated with D-C and A-C current. The radial fan **40** therefore rotates in a single direction (arrow **42** in FIG. **5**) and, consequently, its blades or vanes **41** are curved so as to extend outwardly from the axis of the fan **40** and rearwardly, as considered in the direction of arrow **42**. Since the motor **117** is a universal motor which is operated with current at high voltage, it is preferably surrounded by a protective cylinder **39** of insulating material. The rotor package is mounted on the motor shaft by way of an insulating sleeve, not shown. The efficiency of the fan **40** (with arcuate blades **41**) is higher than the efficiency of the fan **31**. Otherwise, the construction of the machine shown in FIGS. **4–5** is preferably identical with that of the machine shown in FIGS. **1** and **3**. Thus, the fan **40** is mounted in the region where the passage wherein the air flows to cool the impeller assembly meets one or more channels for admission of cool atmospheric air in such quantities that the temperature of air rises relatively little in response to exchange of heat with the motor. Therefore, a substantial quantity of the air which reaches the pressure side of the fan **40** can be discharged into the atmosphere (at **137**) without flowing through the passage and through the outlets at the front end of the jacket (not shown in FIG. **4**).

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended

1. In a portable impulse transmitting machine, a combination comprising an electric motor; an impeller assembly operable to transmit impulses to a material-penetrating tool; motion transmitting means for operating said assembly in response to operation of said motor with attendant heating of said motor and said assembly; and cooling means including a housing having a first portion surrounding said assembly and defining a passage provided with at least one first outlet to the atmosphere, said housing further having a second portion surrounding said motor and provided with at least one air-admitting inlet and at least one channel extending along said motor between said inlet and said passage in communication with the latter, and a rotary fan driven by said motor and mounted in said housing between said passage and said channel to draw at least one stream of atmospheric air through said inlet and said channel with attendant cooling of said motor and to force a first portion of said stream into said passage whereby such portion of said stream cools said assembly on its way into and through said first outlet, said housing further having at least one second outlet in the region of said fan and communicating with said channel for evacuation of the remaining portion of said air stream in response to rotation of said fan.

2. A combination as defined in claim **1**, wherein said fan is a radial fan having a suction side facing said motor and a pressure side, said second outlet and said passage being located at the pressure side of said fan so that the motor is cooled by the entire air stream.

3. A combination as defined in claim **1**, wherein said fan is arranged to draw through said inlet and said channel atmospheric air at such a rate that the quantity of said first portion of said air stream is a small fraction of the quantity of said remaining portion of said air stream.

4. A combination as defined in claim **1**, wherein said first portion of said housing comprises a tubular member immediately surrounding said impeller assembly and a tubular jacket surrounding said tubular member, said passage being provided between said tu-

bular member and said jacket and having a first end adjacent to said fan and a second end remote from said fan, said first outlet being provided at the second end of said passage.

5. In a portable impulse transmitting machine, a combination comprising an electric motor; an impeller assembly operable to transmit impulses to a material-penetrating tool; motion transmitting means for operating said assembly in response to operation of said motor with attendant heating of said motor and said assembly; and cooling means including a housing having a first portion including a tubular member surrounding said assembly and a tubular jacket constituting an auxiliary handgrip and surrounding said tubular member so as to define therewith a passage having a first and a second end provided with at least one first outlet to the atmosphere, said housing further having a second portion surrounding said motor and provided with at least one air-admitting inlet and at least one channel extending along said motor between said inlet and said passage, and a rotary fan driven by said motor and mounted in said housing between said channel and said passage adjacent said first end of the latter to draw at least one stream of atmospheric air through said inlet and said channel with attendant cooling of said motor and to force a first portion of said stream into said passage thereby such portion of said stream cools said assembly on its way into and through said first outlet, said housing further having at least one second outlet in the region of said fan for evacuation of the remaining portion of said air stream in response to rotation of said fan.

6. A combination as defined in claim 5, wherein said tubular member has a flange at said second end of said passage and said jacket is mounted between said flange and said second portion of said housing.

7. A combination as defined in claim 5, wherein said jacket consists of synthetic plastic material.

8. A combination as defined in claim 1, wherein said fan is rotatable about a predetermined axis and comprises a plurality of straight blades extending radially outwardly from said axis.

9. A combination as defined in claim 1, wherein said fan is rotatable in a predetermined direction about a predetermined axis and comprises a plurality of arcuate blades extending outwardly from said axis and rearwardly with reference to said direction.

10. A combination as defined in claim 1, wherein said motor is an alternating-direct-current motor.

11. A combination as defined in claim 1, wherein said motor is a polyphase-current motor.

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